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TREATMENT OF WOUNDS INFLICTED BY THEM.

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PAUL B. BARRINGER, M.D.,

UNIVERSITY OF VIRGINIA.

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THE VENOMOUS REPTILES OF THE UNITED STATES, WITH THE TREATMENT OF WOUNDS INFLICTED BY THEM.

BY PAUL B. BARRINGER, M.D.,
University of Virginia.

THE more perfect the conception of a mechanism which inflicts an injury, and the more perfect the comprehension of the physiological and pathological changes which ensue as the result of such an injury, the more perfectly will the knowing surgeon be enabled to treat it. From my belief in the above statement, I have decided to lay before a body of surgeons a paper which possibly has equal claim upon the attention of naturalists.

American snakes are divided by herpetologists into three great families—the *Colubrinæ*, the *Elapidae*, and the *Crotalidæ*. The Colubrine snakes will not number, under a strict classification, more than some sixty-five or seventy species, and they include about nine-tenths of all American snakes. Moreover, this large family is composed entirely of harmless snakes—that is, of snakes without fangs or poison sacs, and whose bite is no more injurious than the scratch of a briar. As this class includes some, however, which are popularly supposed to be very deadly, I will allude to them though they fall without the limits of this paper. I do this from the fact that I have recently learned from reliable sources of a death from an overdose of whiskey, administered for the bite of a harmless snake. The *Heterodon* family, the so-called “Spreading Adders,” are, by the great mass of the people, believed to be next in venomous power to the rattlesnake itself. They



are perfectly harmless, and their evil name comes entirely from the fact that in coloring, form, and even in action, they mimic the venomous types. The spotted spreading adder (*H. platyrhinus*), often called the "Blow Snake," from the manner in which it distends its body with air and emits it through the throat with a rushing sound, is found both North and South in the Eastern United States, and is greatly feared, though perfectly harmless. The "Black Adder" (*H. niger*) is limited to the South, and is the special horror of the uninformed. The smaller form (*H. simus*) is killed as a "young rattlesnake."

The *Tropidonotus* family furnishes two members that are popularly considered very deadly. The "Water Snake" (*T. sipedon*) furnishes the foundation of many blood-curdling stories North, while the reputation of his Southern brother (*T. fasciatus*) imparts a flavor to "snake medicine" not otherwise obtained. These are both confounded with the true water moccasin, and suffer by the confusion. As it becomes a matter of some moment in the South, where all three are found, to distinguish them from the truly venomous moccasin, I will give the method further on. Though bold and blustering, and striking viciously when approached, these have no fangs or venom. I might mention others which, in certain localities, are feared without cause, but the misrepresentation of the above is universal.

Turning to the next family—the *Elapidæ*—we find family and genus represented by a single species, of many varieties. This snake (*Elaps fulvius*) is, however, of especial interest to us, as it is a venomous serpent, though presenting the general character of a harmless one. This small and beautiful serpent is the sole American representative of the dreaded *Cobra* family of India and Africa. First described by Audubon (and drawn by him in one of his ornithological plates) as the Harlequin snake, Holbrook, in 1842, pointed out the fact that it had venom fangs. Under the names of Harlequin snake, Bead snake, and Coral snake, this beautiful little reptile has often been described, but seldom in its true light. Shy in its

habits, and hence not often seen, it is not considered common anywhere, and yet it extends from Virginia to Texas. Gentle of disposition, and never aggressive, it often will not bite when handled, and seems too small and beautiful to be harmful. Dr. S. Weir Mitchell, of Philadelphia, in a most interesting and complete article on the "Poison of Serpents," in the *Century Magazine* of August, 1889, says of this snake that it is "too small with us to be dangerous to man." It is to prevent you from falling into a similar error that I report the following case:

A workman was bitten on the hand by a small snake while playing with it. He killed the snake, and thought little of it. For a while no pain or general effect followed. In less than half an hour, however, pain in the arm and some evidence of loss of muscular power came on, and, in spite of the aid of a physician called in, at the end of eighteen hours he died. An examination of the snake showed it to be "small, and its body was encircled by bright-colored bands. An examination of its mouth showed two fangs in the upper jaw." Mr. Charles E. Coe reports this in the *Scientific American* of June 27, 1891, and refers to Dr. Mitchell's error. He also refers to other cases that seem to have come under his knowledge where a fatal result followed the bite of this snake.

In various parts of the South, from Virginia to Texas, you will hear tales of a beautifully colored snake whose bite is deadly. These tales are too uniform in their coloring to be ignored. But having no accurate description to go upon, and knowing that most of these gorgeously colored snakes are not poisonous, mistakes are liable to occur. I will, therefore, give you a description that will, I think, enable you at all times to recognize it. It is small, from sixteen to twenty inches long. The neck is full, making the head seem small and hardly separated from the body. The general body-ground is a blue-black, marked as follows: Behind the head, and extending forward under the throat, is a yellow band. Behind this, on the body, are a dozen or more wide brick-red bands, extending to the belly, and each red band is bordered by a narrow

band of yellow before and behind. The tail is barred with yellow, and tipped with the same. The ventral plates behind the anus are all *divided*, the only poisonous snake in America in which this is true. The geographical range of this snake is from Southern Virginia around the South Atlantic States to the Gulf; up the Mississippi Valley to Missouri, and thence to Texas. Common nowhere, it is most abundant in Florida, and there seems to attain a greater size than elsewhere. Specific names have been given to several of its varieties, but it is doubtful if they will hold.

The remaining family—the *Crotalidæ*—includes all the other venomous snakes in the United States. Not only is this the larger number, but they are snakes that are limited to this hemisphere. While the Crotaline snakes may be classed with the Vipers of the Old World, they present some characters so peculiar and constant as to entitle them to a special division. One of these is a deep pit between the eye and nostril, and below, a line joining these, and hence they receive the name of “pit vipers.” This family includes our rattlesnake tribe, with its various subdivisions, and also the copperheads and water moccasin.

The rattlesnakes are divided into two genera by structural peculiarities that any observer would notice, and as it is a distinction of some practical bearing, I will ask your attention. The rattlesnakes that inhabited the open prairies of the Northwest, and to which the Indians applied the name “Massasauga” (*Sistrurus catenatus*), and the “Ground rattlesnake” of the South (*Sistrurus miliaris*) have the top of the head as far back as the eyes covered with large scales. The Diamond rattlesnake of the South (*Crotalus adamanteus*), and his more Northern brother, the Common rattlesnake (*C. horridus*), have the head covered with small scales almost up to the nose, the eyes only being covered each by a large plate. For reasons that are not altogether understood, the latter genus is the more to be feared as a poisoner. The ground rattlesnakes of the South do not attain a size sufficient to make them greatly feared, but their Western relatives often reach five feet in

length, and yet their bites do not produce so disastrous results as the bite of a common rattler or a diamond rattlesnake of the same size. In size the common rattlesnake seldom exceeds four feet, while the diamond rattlesnake of Florida and of Texas will sometimes nearly double this. Without going further into the different varieties of rattlesnakes—some fourteen or more—we may say that they all have rattles, and, beyond the fact that the genus *Sistrurus* does not seem, weight for weight, as poisonous as the genus *Crotalus*, they are poisonous in proportion to their size. The American copperhead is, perhaps, the most widespread of any single species of American venomous serpent; and while the opinion is not warranted by the facts, I know of no locality in which the rattlesnake and the copperhead are found side by side, in which the inhabitants do not fear the latter the most. In truth, the rattlesnake, drop for drop of venom, is the more poisonous, but his life-habits are such as to make bites from him quite rare, while with the copperhead they are common. This arises from the difference in temperament, if I may so speak, in the two snakes. Observe them in captivity, and you will at once see this difference. The rattlesnake is sluggish and slow in movement. It is boldly indifferent to approach, and half the time will not take the trouble to coil when approached. At rest it lies with the head drawn down on the coil, and will seldom attempt to strike except from a coil. How different with the copperhead! Ever on the *qui vive*, he coils when he hears you coming. Whether fresh or tired, he will not put his head down, but keeps it well up, ever on the alert. As his classical name signifies (*Agkistrodon contortrix*), he is a snake of action. He can strike under conditions where a rattlesnake would be helpless. Some of the feats that I have seen this serpent perform in this line seem incredible. I have seen him strike the sole of the foot through an opening in the floor not appreciably larger than the snake's head. This summer I knew a child bitten by a horizontal blow from under a warped plank on a barn floor. It is the vicious nature and extreme agility of this pest rather

than its real poisoning power that makes it so much to be feared. As before stated, it is very widespread. Under the names of Copperhead, Highland Moccasin, Cotton-mouth and Pilot, its different varieties are found throughout the United States, east of the Rocky Mountains. In the mountain regions of Southern Virginia, North Carolina, and Tennessee we have a variety (the *atrofuscus* of Troost) which perhaps, is a different species, but certainly presents no generic difference. In simple coloring, snakes vary greatly with the locality, conforming as they do to their environment. Leaving the copperheads, we come to another branch of the same genus—the Water moccasin (*Agkistrodon piscivorus*). South of a line drawn from Norfolk to about Cairo, Illinois, this reptile abounds. Not having the predilection for barns, corn-cribs, and gardens that its kinsman, the copperhead, seems to possess, but seeking the meadows and swamps near water, it is not so much to be feared, but is of about the same poisoning power. Mitchell puts it as slightly less, but from cases that I have seen, I think that the average bite of this reptile is about equal in severity to that of the copperhead. Its short, compact body makes it seem much 'smaller than it really is; the average specimen will be heavier than the average copperhead. It is this malicious reptile that has given the widespread fear of water snakes throughout the Union, but this fear is without foundation at the North. This rough, slime-befouled snake is, as its name implies, a fish eater. From sheer malice it will kill fish too large for it to swallow, and this malicious spirit is shown toward other snakes. If a colubrine snake is placed in a case with a rattlesnake, it will be treated with contempt; but if caged with a water moccasin it will be killed.

This is the complete list of all the poisonous snakes of the United States. While it is not within the province of this paper to give any detailed account of the structural characteristics by which each may be told, I will give a key that will enable anyone to tell a poisonous snake when killed. Leaving out of consideration the black, red, and yellow Elaps above described, any American snake with the pit between

the eye and nostril is a venomous snake, and this is absolutely certain if, in addition to this, you find one or more ventral plates behind the anus *undivided*. Of the secondary characters that distinguish our venomous snakes may be mentioned the following: an elliptical pupil placed vertically, a triangular head, narrow neck, and a blunt tail (rattle or no rattle). Living young within the gullet, or eggs in advanced stages of incubation in the ovisac, are likewise distinguishing features, as all of our crotaline snakes are oviparous.

Leaving the snakes, we come to an American lizard that, in spite of some protests to the contrary, takes its place among the venomous reptiles of the United States. I allude to the Gila Monster of Arizona and New Mexico. This hideous reptile, in its tough armor of orange and black, has been the subject of no little controversy among medical writers. With the Apache Indians, Mitchell, and Reichert on one side, and Yarrow and others on the other, the war still goes on. But one fact remains, that men have died from the effects of the bite of this lacertilian. I am able to add other cases to those previously reported. Dr. Charles C. Barrows, of New York, late of the United States Army, in reply to a letter of inquiry on this subject, writes me as follows:

"I have known of two deaths from this cause (Gila monster). In each case the man bitten was drunk, and the circumstances surrounding the cases were almost identical. In one case a crowd had tormented and worried the monster until he was in a violent rage. A man picked the animal up, and was bitten deeply in the forearm. He had all the symptoms of cardiac depression, and although he was freely plied with stimulants, within a few hours he was dead.

"The other case occurred near Tombstone, and except that the man was bitten on the thumb, was similar in detail and ending."

Similar deaths have been ascribed by the non-venomous side of the controversy to "a mixture of disease, Gila monster, and bad whiskey," but the facts of case remain.

Let us now turn from the reptiles themselves, and take up

the Mechanism by which they administer the venom to the subject of their wrath.

The little Elaps, the first considered, has in common with all the Cobra family, to which it belongs, on either side of the upper jaw a single permanently erect and immovable fang. This is pierced by a venom-duct, opening near the point, and communicating with a comparatively large venom-gland behind the eye, and running down into the neck. The set of the teeth is such that if they catch, they will hang—*i. e.*, they will pull upon the tissues, and drag in more deeply. As in other snakes, the forcible closing of the mouth upon the part bitten compresses the so-called venom-sac, and forces out the fluid.

In the *Crotalidæ*, by far the greater number of our venomous snakes, we have an entirely different and more complicated mechanism. In these, as in all the Vipers, with one exception, we have the fangs large and movable, lying folded back when at rest, and capable of being erected and brought forward when striking. This act is performed by the rotation of the superior maxillary bone, in which they are firmly fixed, on a process of the lachrymal. This is partly a muscular and partly a bony lever movement. The fangs are relatively large, and not regularly curved, but consist of two segments of an arc of given radius, joined at an obtuse angle. For this reason, the tooth is seldom or never sent to the hilt, so to speak, but seems best suited for tearing or ploughing the tissues. The tooth of a serpent is formed of a flattened plate, folded to form a tube, and the opening at its end, where not joined, is the exit of the venom-duct. In the snakes under consideration, the opening, contrary to the general belief, is in the *convex* side of the tooth. If we accept the fact that it is a cutting hook, and not a stabbing tool, the opening is placed just right. The tissues are uninjured on the concave side where the tooth hangs, but are more or less torn on the convex side. About the same mechanism is used to propel the venom from the sac as in the preceding. One of the temporals, and the sphenopterygoid muscle, so-called, make

pressure upon the sac, and squeeze out its contents the instant the fang is engaged. In some snakes, the copperhead especially, even if the fang fails to engage, the venom is squeezed out and thrown quite a distance. The venom-gland in the *Crotalidæ* is placed below and behind the eye. It is of the compound sacculated type, and from each of its many lobules the ducts run downward and forward to join a large duct somewhat expanded—the so-called venom-sac. Where this duct or sac joins the tooth at its ampulla-like base, the duct is very small, and it is claimed by some to have a sphincter, which I have never been able to distinguish. The true method of closure here lies in the fact that while the tooth is folded back, this constricted portion is drawn tight over the base of the tooth, and when the fang is erected, it is relaxed. The mechanism is the same in all the rattlesnakes, copperheads, and moccasins.

Turning to the venom apparatus of the Gila Monster, we find a mechanism differing greatly from either of the above. The venom fangs, if the lizard's twelve or more lower teeth may be so called, are sharp and nearly straight. A recent writer on this subject describes the venom-sacs as located at the base of each tooth, and intimates that the grooves found in the teeth carry their venom into the depths of the wound. This does not agree with my own dissections in the least. In all animals (five) dissected by me, I find the following :

There are eight, or, at most, nine curved teeth in each side of the lower jaw, ossified to its upper surface, lacertilian-fashion, and not implanted in its substance. These teeth present a groove from base to apex as the result simply of their being made of a flat plate folded on itself, shell-fashion. The only "venom-gland" that I could ever find is an enormously developed salivary gland of the serous type, lying *external* to the body of the inferior maxilla, and extending from the symphysis backward and downward. I should call this gland a sub-mental gland. Just external to the line of the inferior teeth is a very marked and deep fold of mucous membrane, a peculiar and pronounced trough-like cavity, and into the

bottom of this, *between each of the teeth*, the ducts from the gland before mentioned open by large distinct openings. While the teeth are much similar, this condition does not obtain in the upper jaw. This animal cannot bite, therefore, unless the object seized can be gotten within the mouth. When it does seize, it holds on, shaking the object held as if to sink its fangs deeper and work the saliva-like fluid into the wound. You can readily see how this trough-like cavity, as it is pressed upon by the mucous membrane of the gum being pressed down, will readily discharge its contents into the openings made by the teeth. The owner of this queer device is sluggish and peaceful, and only when he is tormented and worried can he be made to bite.

Let us now consider the Venom of these pests. While to L. Bonaparte and others great credit is due for pioneer work in this field, it is to Drs. Weir Mitchell and his colleague in labor, Dr. Reichert, that we owe a debt of gratitude for what is really known on this subject. Through them we learn concerning serpent venom that it is a complex proteid compound, having two distinct factors, which differ one from the other markedly.

The first of these is *venom peptone*. It is, as its name implies, a highly diffusible, modified albumin that is very rapid in its penetration of the tissues when injected subcutaneously, or even when swallowed. Its physiological action is as follows: Injected into the tissues, as a crystalloidal body, it passes with ease into the blood and lymph currents. Its first effect is to depress the heart's action, and in large enough dose will stop it at once in diastole. This effect is usually slight however, from American serpents, but not invariably. It produces but little of the marked local effect seen when the other type of venom proteid is injected. After quite a period some swelling is seen, but at no time is it marked. In the meantime it is beginning to show its selective properties upon the nervous system, and an acute ascending paralysis of the cord results.¹ Death by asphyxia ensues when the respiratory

¹ Marine-Hospital Reports, 1890.

centre is reached. Foektistow shows that the cardiac depression is due, not to the influence on the heart muscle, but to disturbance of function in the ganglia of cardiac control, both extrinsic and intrinsic. The same writer shows that strychnia convulsions are checked at once by snake venom, but I regret to say that this was not demonstrated of venom peptone alone, though it was, from what we know of the other constituent, doubtlessly the agent. As regards its influence on the blood, Kinyoun shows that Cobra venom, which is nearly all venom peptone, has no decided influence in modifying the coagulability of the blood.

The other potent factor of serpent venom is *venom globulin*. This class of proteids—the globulins—as you know, are all soluble in dilute saline solutions while precipitated by saturated saline solutions. In accordance with the theory of Schmidt, this globulin class includes two out of the three (fibrin) factors concerned in the coagulation of blood. Looking, then, at the ease with which these globulins take upon themselves a change of form, and the close relationship that venom globulin bears chemically to the usual clot constituents of blood, we cannot be surprised if we learn that the first marked action of venom globulin is the production of a change in the coagulating power of the blood. While it has not the power of passing through animal membranes that venom peptone has, and hence may be swallowed with impunity, it seems to have the power of dissolving animal membranes, so quickly does the blood rush out of its vessels. This causes a swelling of the soft parts so quickly that I have known a boy's foot to be markedly swollen by the time he ran two hundred yards. While this pronounced local effect is taking place, the same series of changes are taking place throughout the body, and if the quantity of venom injected be great enough and life be prolonged, we have bloody extravasations on every mucous and serous surface in the body. But venom globulin is a nerve poison as well as a local one. *Pari passu* with the changes aforesaid, we have a gradual but not so pronounced paralysis

of the nerve centres of the cord from below upward, and if the amount be great enough, ultimately death from asphyxia. The temporary heart disturbance found in poisoning from venom peptone is found here also, and about in the same degree. But the most pronounced change in the circulation is noted in the immense and rapid fall in blood-pressure. Foekistow found this to be due, not so much to the extravasations before mentioned, as to a vasomotor paralysis of the splanchnic area, and a resulting drainage of the general blood of the body into this area. Injections of defibrinated blood into the bitten animal raises the pressure only while it lasts, even when injected in great amount.

Applying this knowledge to our American snakes, we find the following :

The venom of the Harlequin snake (*Elaps fulvius*) has never been subjected to examination, as far as I can learn, and we must therefore judge by analogy. As the *Elaps* belongs to the Cobra family, Cobra venom may safely be taken to represent it. This venom, nearly all peptone, and only 1.75 per cent. globulin, would give us little local action and pronounced paralytic result. I have looked up the careful estimates of amounts likely to prove fatal, and find that for fresh Cobra venom, 0.00008 of a gramme per kilo is a fatal dose (Vincent Richards), while of dried Cobra venom about 0.002 of gramme per kilo was necessary (Kinyoun). For fresh venom this is about $\frac{1}{1500}$ of a grain per pound of weight. With these figures, the *Elaps* seems quite a large snake.

Turning next to our Rattlesnakes, we find a very different story. The venom of the Diamond rattlesnake, probably our worst, contains 24.6 per cent. venom-globulin (Mitchell), and but little venom peptome. Hence, we would have pronounced local effect and a much more uncertain and slow paralytic result. As to the amount of venom that a rattlesnake contains for a given size, so much depends upon the time which has elapsed since he last struck that any series of observations, to be of any value, must extend over quite a time, and be

made upon a large number of animals. I am at work upon such a table now, but for so short a time, that any result given would be little short of guesswork. I do not think, however, that it will be found ultimately to be far from one gramme of venom per kilo of snake. From a number of measurements, I find that a snake will have to be nearly four feet long to weigh a kilo. Such a snake would, therefore, give about 15 minims of venom as his average. Taking Fontana's estimate of $\frac{1}{60}$ of a grain per pound of weight as the fatal dose, we find that 3 minims absorbed would produce death in a one-hundred-and-eighty-pound man. It should be stated, however, that in estimating this amount per snake, we took in every case all that could be obtained, urging the most persistent biting on his part, at the cup. No snake of four feet in length can deliver anything like 15 minims in a wound at one blow.

*Turning from the rattlesnakes to the other Crotalines, we find that the copperhead gives of venom globulin about 8 per cent, and the water moccasin a little less, while their venom peptone is little.

In their *Smithsonian Report* of serpent venom, Drs. Mitchell and Reichert state that they found bacteria of various kinds in venom, and that they were harmless. I can readily conceive that a diseased snake might have bacteria in its venom-sac, but that they exist in the venom of the average snake I am convinced is an error. In conjunction with my colleague, Prof. Tuttle, of the University of Virginia, I tested the venom of various snakes, and in no instance did I find bacteria if taken from a sterilized fang. The procedure was as follows: The snake was caught with the staff, the mouth drawn open, and the upper jaw held up by a piece of cloth in the mouth through which the fangs projected. Over the fangs were slipped layer after layer of antiseptic filter-paper until only the tip was exposed. By pressing the side of the head a few drops of venom were expressed, and this was allowed to run, to clean the duct. After this, no venom removed through the fang (from a healthy snake) ever gave a single colony, though tested in media of

various kinds. While on the subject of healthy snakes, I may mention a find that we did make during these examinations. In expressing the venom of a big "four-foot" rattlesnake (*C. horridus*), we noticed a white, flaky material coming out from one of the fangs, and upon microscopical examination found in the venom a living colony of nematode worms. These worms lived in a small vial of mixed venom from various snakes until it decomposed—about two weeks.¹

I must, therefore, conclude that the bacteria at various times reported in venom came from the serpent's mouth, and that these mouth-bacteria are harmless is more than doubtful. If any one will examine any series of reports on bites of American snakes, he cannot fail to be struck with the fact that about one case in every five is complicated with symptoms of septicæmia. This is especially true of Yarrow's series of cases in the *American Journal of the Medical Sciences*, April, 1884. That the bacteria of infection do not reside in the venom I feel assured. That they come from the snake's mouth, and that they are often pyogenic, I am absolutely certain from repeated experiments in which the bite of a non-venomous snake (*Heterodon*) was followed by pus formation too frequently to be merely accidental. This should cause us to modify our treatment of snake-bites—at least, enough to bring them within the pale of modern surgery. The results of Kin-youn's experiments with Cobra venom as a germicide are strongly corroborative of the views here put forth. Not only are pyogenic bacteria not found in venom, but a 1 per cent. solution of Cobra venom produces a decided inhibition to the growth of many bacteria, including streptococcus pyogenes and staphylococcus pyogenes aureus.²

Leaving the snakes' venom, and turning to the Gila Monster, we find that we know far less about it. That it is a modified saliva is certain, and that it comes from their sub-

¹ The species to which this worm belongs was not determined, and probably has never been described. It is possibly a member of the *Strongylus* family.

² American Marine-Hospital Reports, 1890.

mental gland I also feel assured. It would seem from the divergence in the results obtained by Yarrow and Mitchell, both careful observers, that it differs in toxic power under different conditions of body. To those familiar with the immense variation in the saliva of other animals when produced under varying stimulation of the secretory nerves, it would not seem too much to look for some such change here. The peculiar odor of the saliva found in these animals is most marked when the animal is enraged. Moreover, I have known of no case in which a serious result followed its bite, in which the animal was not in a fury of rage.

The diagnosis of a snake-bite is usually easy with American snakes, as all except the Elaps produce marked local swelling and extravasations. But if it were an Elaps, the absence of local lesion, the decided mental hebetude, almost coma, dilated pupil, and general paralytic condition might, especially if the smell of whiskey be upon the breath, mislead with serious results.

The wound made by a non-venomous snake is usually different from that made by a poisonous one. In the former, a series of small punctures in a double line shows the point struck, while in the latter, if there be more than two, the others are comparatively insignificant.

While in certain countries, as in India, death from snake-bite runs up into the thousands per annum, the returns of death from this cause in the United States amount to almost nothing. And yet every practitioner in the country districts meets cases almost yearly. These two facts together give us as favorable the general prognosis in the wounds inflicted by our reptiles. Taking them in detail, I can give no statistics for the Elaps, but as it is not a common snake, and of gentle disposition, its bites must be comparatively few. From a series of thirty-eight rattlesnake bites that I have gotten, I think that taking man, woman, and child, the mortality will not run over 10 per cent. This is meant to cover the region inhabited by the huge Diamond rattlesnakes, as well as the

less dangerous *Sistrurus*. As regards the copperhead's bite, I have (including Yarrow's nine cases) sixty-nine cases, with one death. This was a boy six years of age, and it took place after several days. All in all, I do not believe the mortality from the copperhead's bite will run over 1 per cent., taking man, woman, and child bitten. The water moccasin being, from its peculiar habitat, less apt to bite children, will fall below this. In fact, I have never been able to learn of an authentic case of death from the moccasin's bite.

TREATMENT OF REPTILE BITES.—In the first place, the preventive treatment lies in keeping out of the region inhabited by these pests, or, if you must expose yourself, wearing good protective leggings, etc. The hog is, of all creatures known, the greatest practical enemy of the snake. In some swamp and mountain districts of the country, the abundance of the bears prevents the raising of hogs, and here the snakes abound, the bear being the unintentional protector of the snake.

Leaving preventive treatment out of consideration, we may divide the immediate into two heads :

First, the local treatment. Every individual whose occupation exposes him to the danger of such wounds, should know that immediate attention to such wounds will save his life in almost any contingency. With a knife, or even with a thorn, cut or tear open the wound until it bleeds freely. As almost all bites are on the extremities, the patient may be able to suck the wound. If so, do it at once—a sore mouth or decayed tooth makes no difference ; the very act of suction will prevent the entrance of the poison into a mouth lesion. If the surgeon is at hand, which seldom happens when the bite first occurs, he should open each of the punctures transversely to the line of lymph and blood flow, and apply a cupping-glass. If at hand, a solution of permanganate of potash (10 per cent.) or a strong solution of liquor potassæ, injected into the wound, will destroy the physiological activity of the venom entirely. If he can do two things at the same

time, let him likewise tie an extemporized tourniquet around the limb at once. The above treatment is entirely independent of the kind of snake, provided only it be poisonous. Now let me say one more word in regard to the local treatment. In 5 per cent. of all bites that are recovered from, a chronic septicæmia results. This is due to the fact that almost all snake-wounds are more or less infected with pyogenetic bacteria from the saliva of the snake. The viscid mucus always in a serpent's mouth to enable it to swallow its prey, is a perfect nidus for the propagation of these germs. The abundance of this mucus gives to our copperhead in many localities the term cotton-mouth, and it is from them especially that we receive these septic bites. In viewing the local effects of venom globulin, in which our snakes abound, we saw a condition produced most favorable to the spread of pyogenic and saprophytic bacteria, and they very readily take hold here. Therefore, all snake-wounds should have applied to them the same surgical care applied in these days to other wounds. This chronic septicæmia seems to produce a recurrent neuritis in the nerves distributed to the part bitten, and often when similar telluric conditions again obtain, we are apt to have herpetic eruptions break out at the seat of the wound.

Turning to the constitutional treatment, we find that alcohol in moderate quantities (not over a half pint all told) is an agent usually sufficient to maintain the heart's action and blood-pressure at a safe point. But as the poison begins to make itself more distinctly felt on the centres, we find that alcohol, especially if the amount of venom be great, is unable to prevent a dangerous fall in the force of nerve impulses sent out, and we must assist it by strychnia. One-thirtieth to one-twentieth of a grain hypodermatically administered, will increase the nerve-centre tone, and restore the waning powers. To avoid gangrene of the limb, as the result of our tourniquet, it will be necessary at intervals to remove it, and at these times more or less venom will enter the system. By repeating the alcohol, strychnia, and, in case of a Gila Mon-

ster. bite, digitalis, we may tide over these periods, and save a patient under conditions most adverse. The above include all remedies of demonstrated power. Bibron's antidote, the Tanjore pill, *viola sagittata*, squirrel's ear, sweet oil, and many other remedies, each have their advocates, but I know nothing of them. The means that I have suggested have in very many cases saved human life, but they should be in the hand of a man who will not lose his head from excitement.

